



Key Considerations for Retrofit Programs

Consideration the following

- Retrofit Technology Checklist
 - Emissions Targeted
 - Engine Condition and Age
 - Perform maintenance
 - The condition of the engine is an important factor in making a decision whether to install retrofit control technology
 - How long vehicle/equipment is going to remain in service
 - Retrofit at the time of engine rebuild can be advantageous
 - Retire/Replace
 - Size
 - Properly sized control systems ensure low back pressure and maximum performance
 - Vehicle Integration
 - Space, accessibility and exhaust temperature are important vehicle integration issues
 - Devices are often installed in-line or as a muffler replacement



Consideration the following ...

- Retrofit Technology Check List (cont.)
 - Model Year
 - Generally, only 1994 and newer should get PM filters
 - Some newer engines came with DOCs from the factory
 - Fuel Type/Quality
 - For PM control, <15 ppm sulfur fuel allows for maximum emission control performance (even for DOCs) and best filter regeneration characteristics
 - Maintenance
 - Vehicles to be retrofitted should be properly and regularly maintained—key factor for success
 - Retrofit technologies should be maintained per their manufacturer's recommended procedures



Frequently Asked Questions Concerning Retrofit Programs

- Costs
 - Costs depend on many factors including:
 - Number of vehicles retrofitted (sales volume)
 - Retrofit technology used (oxidation catalyst, filter, etc.)
 - Engine size (displacement)
 - Engine out emissions
 - Fuel quality
 - Exhaust temperature and duty cycle (These factors will affect which retrofit technology will be appropriate.)
- Costs are expected to decrease as the market expands



Frequently Asked Questions Concerning Retrofit Programs (cont.)

Technology	Cost per Device/System (\$)
Diesel Oxidation Catalysts (DOC)	500 to 2,000
Diesel Particulate Filters (DPF)	7,000 to 10,000
Combined Lean NOx Catalyst/DPF Systems	15,000 to 20,000
EGR Systems	13,000 to 15,000
SCR Systems	12,000 to 20,000

Notes: DPF costs are higher for active systems and systems that include backpressure monitoring.



Frequently Asked Questions Concerning Retrofit Programs (cont.)

- Drivability
 - Properly selected retrofit technologies do not impair driving performance
- Maintenance
 - Oxidation and lean NO_x catalysts are virtually maintenance free - require only periodic inspection
 - Filters require very little maintenance (ash removal)
 - SCR maintenance, as per manufacturer's specifications
- Effects on Engine Life
 - Properly maintained engines and retrofit control systems do not shorten engine life



Frequently Asked Questions Concerning Retrofit Programs (cont.)

- Fuel Penalties
 - Most oxidation and lean NOx catalysts have no effect on fuel consumption
 - Most filters have no effect on fuel consumption
 - Urea consumption in SCR systems results in an equivalent fuel penalty of 3-5%
 - Systems relying on fuel injection as reductant or heat typically result in 3-5% fuel penalty
 - EGR results in a 1-4% fuel penalty
- Warranties
 - Manufacturers provide various warranties as part of a purchase agreement



Conclusions

- A wide variety of retrofit options are available for diesel engines to reduce HC, CO, PM and toxic emissions
- NOx retrofit controls are emerging
- A growing number of retrofit programs are being successfully implemented
- Technology development continues to expand the range of applications available for retrofit
- A successful retrofit program must be properly designed and implemented

Some Diesel Retrofit Web Sites

- U.S. EPA:
 - <http://www.epa.gov/otaq/retrofit>
 - <http://www.epa.gov/midwestcleandiesel>
- The Manufacturers of Emission Controls Association:
 - <http://www.meca.org>
 - Click on “Publications” to access MECA fact sheets and technical documents on diesel retrofit
- The Diesel Technology Forum:
 - <http://www.dieseltechnologyforum.com/>
- The California Air Resources Board’s Diesel Risk Reduction Program:
 - <http://www.arb.ca.gov/diesel/dieselrrp.htm>

